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EXPERIMENTAL BOTULISM IN DOGS

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As a part of an experimental project to determine the effect of botulinus toxins on different animals, dogs have been fed and injected with unfiltered A and B toxins of *Clostridium botulinum*. The effect on dogs of ingesting the uncooked animal carcass dead of artificially induced botulism was also noted. In a review of the available literature, the susceptibility of dogs to botulinus toxins is not found definitely stated, though Kempner¹ reported that a cat developed profound symptoms of intoxication following the feeding of toxin at intervals. The symptoms observed consisted of local paresis of the hind quarters, slight dilatation of the pupils, hoarseness, and general emaciation. Dickson² also employed cats in microscopic studies of botulinus intoxication.

The toxins we used were produced by seeding the spores of *Clostridium botulinum* in glucose pork infusion broth. After an incubation period of 6 or more weeks at room temperature the toxicity was determined on guinea-pigs. Unfiltered toxins given subcutaneously to guinea-pigs (250 gm.) in 0.001 c c doses produced death in less than 24 hours. Some of the toxins were doubtless lethal to guinea-pigs in smaller amounts, but the minimum lethal dose was not determined. All toxins used in the dog experiments were unfiltered and unless otherwise stated contained the spores and a few vegetative forms of the organism.

The toxicity of the carcasses fed to dogs from cases of artificially induced botulism was not determined, yet from the tissues of some of the animals taken immediately following death, the spores were occasionally demonstrated by cultural methods. In similar fatal cases (pigs) toxin has at different times been demonstrated in the blood stream following death.

SUSCEPTIBILITY OF DOGS TO TYPE A TOXIN

Type A toxin was given to 18 dogs subcutaneously in amounts varying from 0.001 c c to 10 c c (table 1). The course and severity

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¹ Ztschr. f. Hyg. u. Infektionskr., 1897, 26, p. 481.

² The Rockefeller Institute of Medical Research, Monograph No. 8, 1918.

of the illness produced varied in different animals in direct proportion to the amount of toxin given and the weight of the dog. Manifest symptoms were observed as early as 12 hours after exposure, though in most cases 36 to 48 hours elapsed before symptoms were noted. Two dogs that received 0.1 c c subcutaneously died after protracted illness, and 7 dogs that also received 0.1 c c subcutaneously showed symptoms but gradually recovered. A smaller amount (0.001 c c) of toxin failed to produce illness in one animal while 1 c c subcutaneously produced death in 3 of the dogs. Antitoxin apparently protected one of the dogs that received 1 c c of toxin.

TABLE 1
TYPE A TOXIN OF CLOSTRIDIUM BOTULINUM ADMINISTERED SUBCUTANEOUSLY TO DOGS

Date	Weight, Lbs.	Dose, C c	Antitoxin	Results
9/26/21	15	0.001	.....	Remained healthy
9/26/21	15	0.01	.....	Remained healthy
9/26/21	14	0.1	.....	Symptoms of botulism developed in 18 hours; died 9/28/21
3/ 2/22	19	0.1	.....	3/4, stiffness; 3/6, prostration and inanition; 4/10, chronic condition
3/22/22	30	0.1	.....	3/25, slight stiffness and dulness; 3/27, recovery noted; 4/3, recovery complete
3/22/22	31	0.1	.....	Remained healthy
3/22/22	23	0.1	.....	3/25, slight stiffness; 3/29, stiffness aggravated; 4/10, recovery almost complete
3/22/22	25	0.1	.....	3/24, stiffness and incoordination; 3/27, decumbent; 4/10, recovery complete
3/22/22	28	0.1	500 units subcut. 20 days previous	Remained healthy
3/22/22	18	0.1	.....	3/24, stiffness; 3/25, decumbent; 4/1, died
3/22/22	31	0.1	.....	3/24, slight stiffness and incoordination; 3/27, decumbent, emaciated and inanition; 4/10, chronic condition
9/16/21	8	1	.....	Died after 12 hours
9/16/21	14	1	.....	Died after 12 hours
9/16/21	7½	1	500 units subcutaneously	Remained healthy
1/23/22	25	1	.....	Died 1/25/22
9/16/21	10	No treatment	.....	Remained healthy
11/ 8/21	..	10	.....	Sudden illness; died 11/10/21
11/ 8/21	..	10	.....	Sudden illness; died 11/10/21

One c c of unfiltered toxin contained more than 1,000 lethal doses for a 250 gm. guinea-pig.

Type A toxin of *Clostridium botulinum* fed daily for 30 days to a puppy (6 weeks' old) in amounts of 1 c c in milk failed to induce ill effects. Doses of 10 c c to 60 c c of type A toxin administered with pipet or drinking bottle to dogs weighing 10 or more pounds which had been receiving normal rations up to the time of treatment, failed to cause noticeable ill effects. In attempting to determine the effect of acid gastric juice on toxin, the stomach contents of 2 dogs were alkalinized by feeding 50 c c of a 5% sodium bicarbonate solution

followed by 50 c c of type A toxin. In neither case were any noticeable effects observed.

Seven dogs from which food had been withheld for 48 hours before being given 30 c c to 60 c c of type A toxin by mouth developed noticeable symptoms of botulism in 2 to 4 days, followed by spontaneous recovery. A dose of 100 c c produced more profound symptoms terminating in death in some cases about the sixth day.

Dogs receiving 5 c c or more of type A toxin subcutaneously suddenly developed symptoms of profound weakness after an interval of 12 to 36 hours. The affected animals were unable to stand or move but remained in a decumbent position. The muscles were flaccid. Their mental condition remained normal for several hours after the development of the weakness as evidenced by the expression of the eyes and the wagging of the tail when spoken to. Animals in this condition frequently died within 24 hours after the onset of the symptoms. All died within 48 hours.

Dogs receiving smaller doses of type A toxin subcutaneously or sufficiently large doses by mouth developed symptoms more slowly. Affected animals walked stiffly with short steps, followed by incoordination of movement and swaying from side to side. Later, when attempting to walk, they would fall forward on the head. Exertion in regaining the feet was sometimes followed by jerky incoordination of muscles and trismus. In 10 to 24 hours animals in this condition were completely unable to stand. Lacrymation and salivation often accompanied these symptoms. Affected dogs seldom barked, but when forced to move emitted a hoarse, suppressed bark or whine. They refused food and water. Animals decumbent for 2 or 3 days frequently suffered from a swollen tongue which partially protruded from the mouth. The saliva was not excessive but dripped slowly from the lips. At first the saliva was clear and without odor, but later it became a brownish color and fetid in character. A severe cheilitis developed in one case. Respiratory distress was observed in the latter stages of the disease in some dogs.

ANATOMIC CHANGES

Dogs which had received fatal amounts of type A toxin showed a general passive congestion of the mucous membranes, internal organs, brains and meninges. Dogs that survived 3 or 4 days had little solid ingesta in the stomach and small intestine. The content consisted of mucous secretion. The posterior bowel contained firm and more or

less dry feces. Dogs that lingered for a greater length of time showed severe bile imbibition throughout the digestive tract.

SUSCEPTIBILITY TO TYPE A SPORES

Spores of *Clostridium botulinum* type A prepared by washing 5 or more times and centrifugalizing were detoxicated by heating at 80 C. for 15 minutes. One c c (3,800,000 spores per c c) suspension injected subcutaneously into guinea-pigs failed to induce ill effects. The viability of the spores suspension was established by seeding into glucose agar. Doses varying from 5 c c (19,000,000 spores) to 25 c c (95,000,000 spores) were injected subcutaneously into dogs. No ill effects were observed.

SUSCEPTIBILITY TO TYPE B TOXIN

Fifteen dogs, varying in age and size from nursing pups to old dogs weighing 30 pounds, were given *Clostridium botulinum* toxin, type B, subcutaneously, in doses varying from 1 c c to 80 c c. Soreness at the point of injection was generally noticed for the first 24 hours, but no other ill effects could be observed. Dogs kept for several months after the injection of 10 c c of toxin containing spores showed no tendency to develop the chronic type of the disease. Doses of 5 c c and 15 c c of type B toxin were injected intravenously into two dogs. A few hours after injection, slight transitory dulness was noted, followed by complete recovery.

THE EFFECT OF FEEDING CARCASSES OF ANIMALS THAT DIED OF BOTULISM

Fifteen dogs were fed ad libitum, the muscle, liver, kidney, heart, and lung tissues of 2 horses and 6 pigs that had died of experimentally induced type A botulism. The material was fed before spoilage could occur and was consumed in liberal amounts by the dogs. No noticeable ill effects were observed in the dogs ingesting this material.

SUMMARY

Unfiltered type A toxin of *Clostridium botulinum* proved fatal to dogs in doses of 0.1 c c or more administered subcutaneously. Type A spores, detoxicated by washing and heating, produced no noticeable effects when injected subcutaneously into dogs.

Feeding relatively large amounts of unfiltered type A toxin (100 c c) produced illness and death in dogs only when food had been previously

withheld for 48 hours. The effects of other forms of artificially induced fatigue were not determined.

The symptoms of type A intoxication included loss of appetite, muscular weakness, languor, prostration, salivation, congestion of the mucous membranes of the mouth, and respiratory disturbances.

Type A antitoxin apparently protected dogs against lethal amounts of toxin.

Unfiltered type B toxin of *Clostridium botulinum* administered intravenously and subcutaneously in liberal amounts failed to induce manifest symptoms.

The internal organ and muscle tissues of horses and pigs which had died of type A botulism were consumed by dogs without ill effects.

Dogs appear to be satisfactory animals for differentiating A and B toxins of *Clostridium botulinum* following subcutaneous injection